iW3602-30C

AC/DC Digital Power Controllers for Dimmable LED Drivers

1.0 Features

- Isolated AC/DC offline $100V_{AC}/230V_{AC}$ LED driver with different external components value
- Line frequency ranges from 45Hz to 66 Hz
- Intelligent wall dimmer detection
  - » Leading-edge dimmer
  - » No-dimmer detected
  - » Unsupported dimmer
- Hybrid dimming scheme
- Wide dimming range from 1% up to 100%
- No visible flicker
- Resonant control to achieve high efficiency, 85% without dimmer
- Temperature compensated LED current
- Small size design
  - » Small size input bulk capacitor
  - » Small size output capacitor
  - » Small transformer
- Primary-side sensing eliminates the need for opto-isolator feedback and simplifies design
- Tight LED current regulation ± 5%
- Fast start-up, typically 10µA start-up current
- Hot-plug LED module support
- Multiple protection features:
  - » LED open circuit protection
  - » Single-fault protection
  - » Over-current protection
  - » LED short circuit protection
  - » Current sense resistor short circuit protection
  - » Over-temperature protection
  - » Input over-voltage protection
- Up to 10W output power

2.0 Description

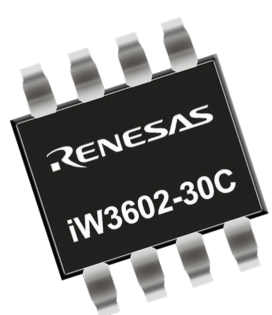
The iW3602-30C is a high performance AC/DC offline power supply controller for dimmable LED luminaires, which uses advanced digital control technology to detect the dimmer type and phase. The dimmer conduction phase controls the LED brightness. The LED brightness is modulated by PWM-dimming. The iW3602-30C's unique digital control technology eliminates visible flicker.

The iW3602-30C can operate with all dimmer schemes including leading-edge dimmer and other dimmer configurations such as R-type, or R-L type. When a dimmer is not present, the controller can automatically detect that there is no dimmer.

The iW3602-30C operates in a quasi-resonant mode to provide high efficiency. It offers a number of key built-in features and uses advanced primary-side sensing technology to achieve excellent line and load regulation without secondary feedback circuitry. Additionally, its pulse-by-pulse waveform analysis technology allows accurate LED current regulation. The iW3602-30C maintains stability over all operating conditions without the need for loop compensation components. Therefore, the device minimizes external component count, simplifies EMI design, and lowers the overall bill of materials cost.

3.0 Applications

- Dimmable LED luminaires
- Optimized for 3W to 10W output power



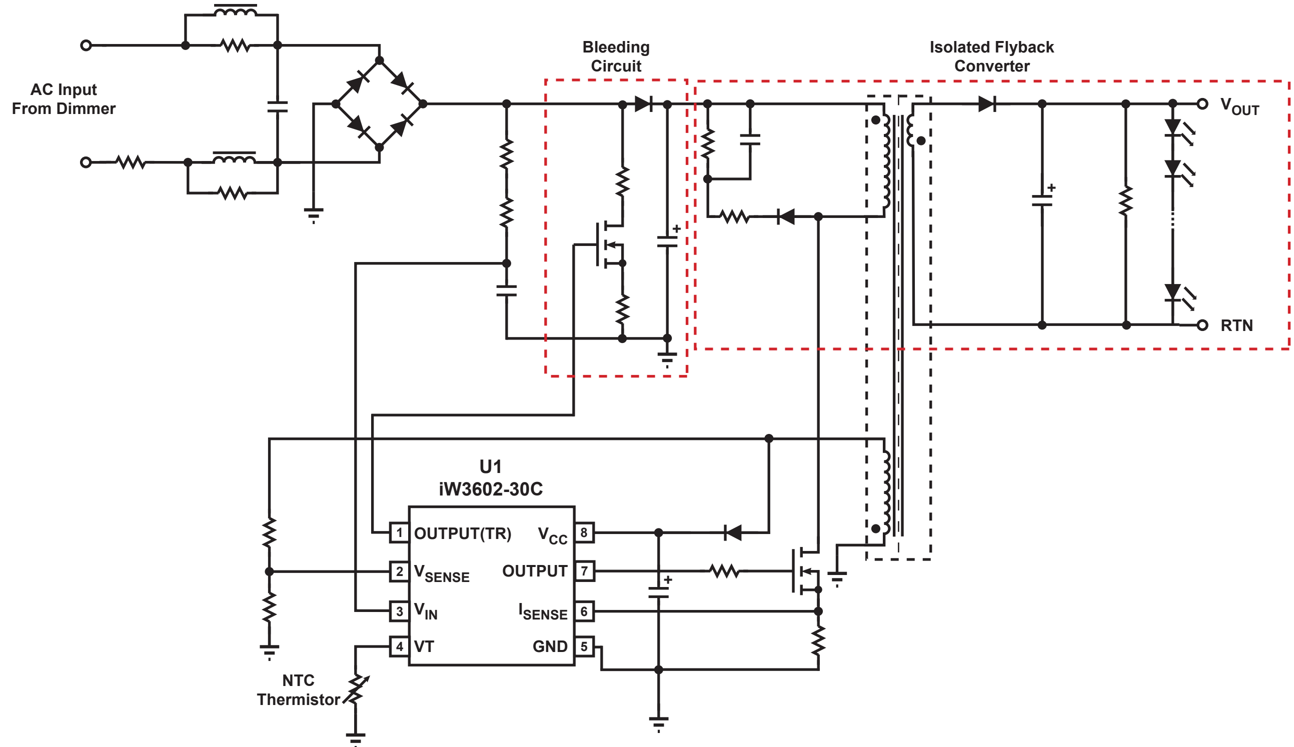


Figure 3.1 : iW3602-30C Typical Application Circuit

4.0 Pinout Description

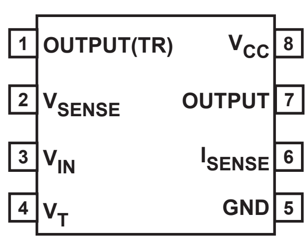


Figure 4.1 : 8-Lead SOIC-8 Package

Pin #	Name	Type	Pin Description
1	OUTPUT(TR)	Output	Gate drive for bleeding MOSFET switch.
2	V_{SENSE}	Analog Input	Auxiliary voltage sense (used for primary side regulation and ZVS).
3	V_{IN}	Analog Input	Rectified AC line voltage sense.
4	V_T	Analog Input	External power limit and shutdown control.
5	GND	Ground	Ground.
6	I_{SENSE}	Analog Input	Primary current sense (used for cycle-by-cycle peak current control and limit).
7	OUTPUT	Output	Gate drive for main MOSFET switch.
8	V_{CC}	Power Input	Power supply for control logic and voltage sense for power-on reset circuitry.

5.0 Absolute Maximum Ratings

Absolute maximum ratings are the parameter values or ranges which can cause permanent damage if exceeded. For maximum safe operating conditions, refer to Electrical Characteristics in Section 6.0.

Parameter	Symbol	Value	Units
DC supply voltage range (pin 8, I_{CC} = 20mA max)	V_{CC}	-0.3 to 18	V
DC supply current at V_{CC} pin	I_{CC}	20	mA
OUTPUT (pin 7)		-0.3 to 18	V
OUTPUT(TR) (pin 1)		-0.3 to 18	V
V_{SENSE} input (pin 2, $I_{Vsense} \leq$ 10mA)		-0.7 to 4.0	V
V_{IN} input (pin 3)		-0.3 to 18	V
I_{SENSE} input (pin 6)		-0.3 to 4.0	V
V_T input (pin 4)		-0.3 to 4.0	V
Power dissipation at $T_A \leq$ 25°C	P_D	526	mW
Maximum junction temperature	T_{JMAX}	150	°C
Operating junction temperature	T_{JOPT}	-40 to 150	°C
Storage temperature	T_{STG}	-65 to 150	°C
Thermal Resistance Junction-to-Ambient [Still Air]	θ_{JA}	160	°C/W
ESD rating per JEDEC JESD22-A114		±2,000	V
Latch-up test per JESD78A		±100	mA

6.0 Electrical Characteristics

V_{CC} = 12V, -40°C ≤ T_A ≤ 85°C, unless otherwise specified (Note 1)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
V_{IN} SECTION (Pin 3)						
Start-up current	I_{INST}	V_{IN} = 10V, C_{VCC} = 10µF		10	15	µA
Input impedance	Z_{IN}	T_A = 25°C		2.5		kΩ
V_{IN} Range	V_{IN}		0		1.8	V
V_{SENSE} SECTION (Pin 2)						
Input leakage current	$I_{IN(Vsense)}$	V_{SENSE} = 2V			1	µA
Nominal voltage threshold	$V_{SENSE(NOM)}$	T_A = 25°C, negative edge	1.523	1.538	1.553	V
Output OVP threshold	$V_{SENSE(MAX)}$	T_A = 25°C, negative edge	1.65	1.7	1.75	V
OUTPUT SECTION (Pin 7)						
Output low level ON-resistance	$R_{DS(ON)LO}$	I_{SINK} = 5mA		30		Ω
Output high level ON-resistance	$R_{DS(ON)HI}$	I_{SOURCE} = 5mA		150		Ω
Rise time (Note 2)	t_R	T_A = 25°C, C_L = 330pF 10% to 90%		150		ns
Fall time (Note 2)	t_F	T_A = 25°C, C_L = 330 pF 90% to 10		30		ns
Maximum switching frequency (Note 3)	$f_{SW(MAX)}$			200		kHz
V_{CC} SECTION (Pin 8)						
Maximum operating voltage	$V_{CC(MAX)}$				16	V
Start-up threshold	$V_{CC(ST)}$	V_{CC} rising	11	12	13	V
Undervoltage lockout threshold	$V_{CC(UVL)}$	V_{CC} falling	7	7.5	8	V
Operating current	I_{CCQ}	C_L = 330pF, V_{SENSE} = 1.5V		4.1	4.7	mA
Zener diode clamp voltage	$V_{Z(CLAMP)}$	T_A = 25°C, I_Z = 5mA	18.5	19	20.5	V
I_{SENSE} SECTION (Pin 6)						
Over-current limit threshold	V_{OCP}		1.83	1.89	1.95	V
I_{SENSE} short protection reference	V_{RSNS}			0.16		V
CC regulation threshold limit (Note 4)	V_{REG-TH}			1.8		V

6.0 Electrical Characteristics (cont.)

V_{CC} = 12V, -40°C ≤ T_A ≤ 85°C, unless otherwise specified (Note 1)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
V_T SECTION (Pin 4)						
Power limit high threshold (Note 4)	$V_{P\text{-}LIM(HI)}$			0.56		V
Power limit low threshold (Note 4)	$V_{P\text{-}LIM(LO)}$			0.44		V
Shutdown threshold (Note 4)	$V_{SH\text{-}TH}$			0.22		V
Input leakage current	$I_{IN(VT)}$	V_T = 1.0V			1	µA
Pull-up current source	I_{VT}		90	100	110	µA
OUTPUT (TR) SECTION) (Pin 1)						
Output low level ON-resistance	$R_{DS\text{-}TR(ON)LO}$	I_{SINK} = 5mA		100		Ω
Output high level ON-resistance	$R_{DS\text{-}TR(ON)HI}$	I_{SOURCE} = 5mA		200		Ω

Notes:

Note 1. Adjust V_{CC} above the start-up threshold before setting at 12V.

Note 2. These parameters are not 100% tested. They are guaranteed by design and characterization.

Note 3. Operating frequency varies based on the line and load conditions, see Theory of Operation for more details.

Note 4. These parameters refer to digital preset values, and they are not 100% tested.

7.0 Typical Performance Characteristics

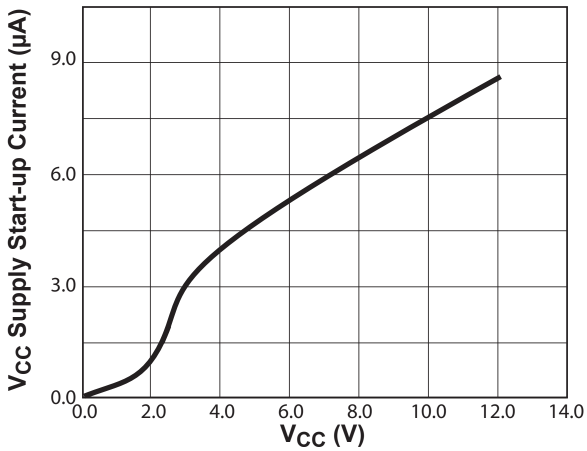


Figure 7.1 : V_{CC} vs. V_{CC} Supply Start-up Current

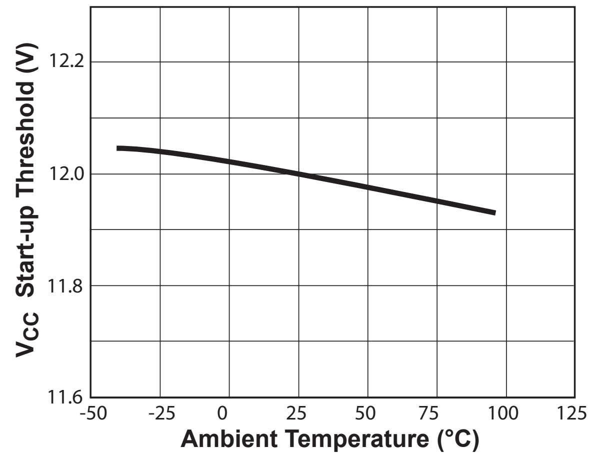


Figure 7.2 : Start-Up Threshold vs. Temperature

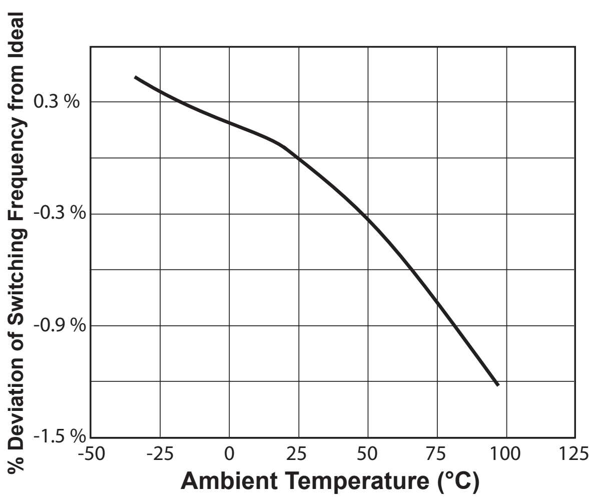


Figure 7.3 : % Deviation of Switching Frequency to Ideal Switching Frequency vs. Temperature

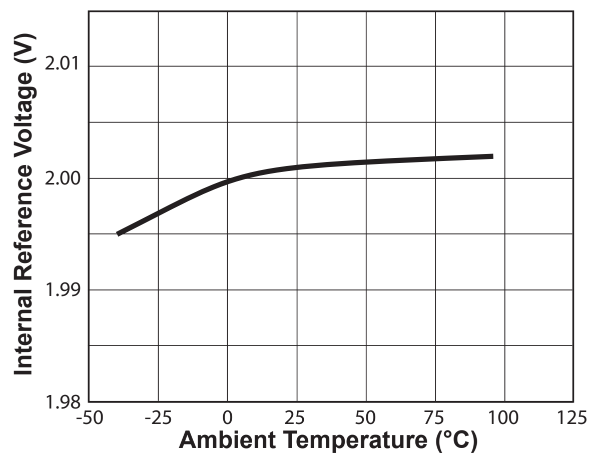


Figure 7.4 : Internal Reference vs. Temperature

8.0 Functional Block Diagram

The iW3602-30C is optimized for low-cost designs supporting leading-edge, R type and R-L type dimmers. The IW3602-30C combines two functions: 1) wall dimmer type detection and dimmer phase measurement; and 2) output LED light dimming. It uses digital control technology, which consists of: 1) bleeding circuit, which serves as a dynamic impedance to load the dimmer; 2) primary side controlled isolated flyback converter. The iW3602-30C provides a low cost dimming solution which enables the LED bulb to be used with most of the common wall dimmers. This allows LED bulbs to directly replace conventional incandescent bulbs with ease. The iW3602-30C can detect and operate with leading-edge dimmer and no-dimmer. The controller operates in critical discontinuous conduction mode (CDCM) to achieve high power efficiency and minimum EMI. The iW3602-30C incorporates proprietary primary-feedback constant current control technology to achieve tight LED current regulation.

Figure 3.1 shows a typical iW3602-30C application schematic. Figure 8.1 shows the functional block diagram. The advanced digital control mechanism reduces system design time and improves reliability. The start-up algorithm makes sure the V_{CC} supply voltage is ready before powering up the IC.

The iW3602-30C provides multiple protection features for current limiting, over-voltage protection, and over-temperature protection. The V_T function can provide over-temperature compensation for the LED bulb. With an external NTC thermister attached to the V_T pin, an internal current source develops a voltage across the NTC which is inversely proportional to the LED bulb temperature. If the V_T pin voltage is below $V_{P-LIM(HI)}$, the controller reduces the LED current in order to reduce the LED bulb temperature. If the V_T pin voltage is below V_{SH-TH} then the controller turns off.

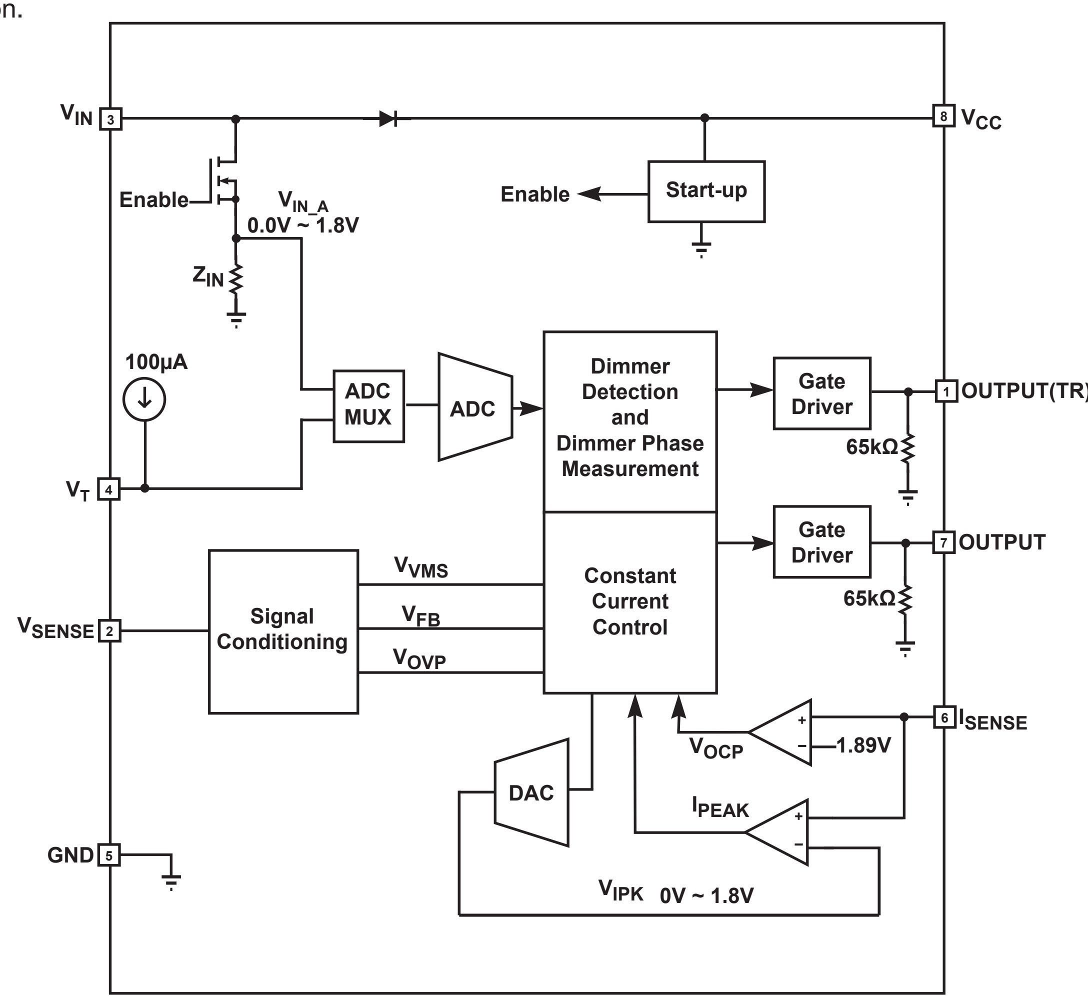


Figure 8.1 : iW3602-30C Functional Block Diagram

9.0 Theory of Operation

The iW3602-30C is a high performance AC/DC off-line power supply controller for dimmable LED luminaires, which uses advanced digital control technology to detect the dimmer type and dimmer phase to control the LED brightness. A PWM-dimming scheme is used to modulate the LED current with a dimming frequency of 900Hz at low dimming levels. iW3602-30C can work with all types of leading-edge dimmers, as well as other dimmer configurations such as R-type or R-L type without visible flicker. The controller can also work when no dimmer is connected.

The iW3602-30C operates in a quasi-resonant mode to provide high efficiency and to simplify EMI design. In addition, the iW3602-30C includes a number of key built-in protection features. Using the state-of-the-art primary-feedback technology, the iW3602-30C removes the need for secondary feedback circuitry while achieving excellent line and load regulation. The iW3602-30C also eliminates the need for loop compensation components while maintaining stability over all operating conditions. Pulse-by-pulse waveform analysis allows for accurate LED current regulation. Hence, the iW3602-30C can provide high performance dimming solutions, with minimal external component count and low bill of materials cost.

9.1 Pin Detail

Pin 1 – OUTPUT(TR)

Gate drive for the chopping circuit MOSFET switch.

Pin 2 – V_{SENSE}

Sense signal input from auxiliary winding. This pin provides secondary voltage feedback used for output regulation.

Pin 3 – V_{IN}

Sense signal input from the rectified line voltage. V_{IN} is used for dimmer phase detection. The input line voltage is scaled down using a resistor network. It is used for input under-voltage and over-voltage protection. This pin also provides the supply current to the IC during start-up.

Pin 4 – V_T

External power limit and shutdown control. If the shutdown control is not used, this pin should be connected to GND via a resistor.

Pin 5 – GND

Ground.

Pin 6 – I_{SENSE}

Primary current sense. Used for cycle-by-cycle peak current control.

Pin 7 – OUTPUT

Gate drive for the external MOSFET switch.

Pin 8 – V_{CC}

Power supply for the controller during normal operation. The controller starts up when V_{CC} reaches 12V (typical) and shuts down when the V_{CC} voltage is below 7.5V (typical).

High-frequency transients and ripples can be easily generated on the V_{CC} pin due to power supply switching transitions and line and load disturbances. Excess ripples and noises on V_{CC} may cause the iW3602-30C to function undesirably, hence a decoupling capacitor must be connected between the V_{CC} pin and GND. It is suggested that a ceramic capacitor of minimum 0.1uF be connected as close as possible to the V_{CC} pin.

9.2 Wall Dimmer Detections

A dimmer detection, or discovery, takes place during the third cycle after start-up. The controller determines whether no dimmer exists, or there is a leading-edge dimmer.

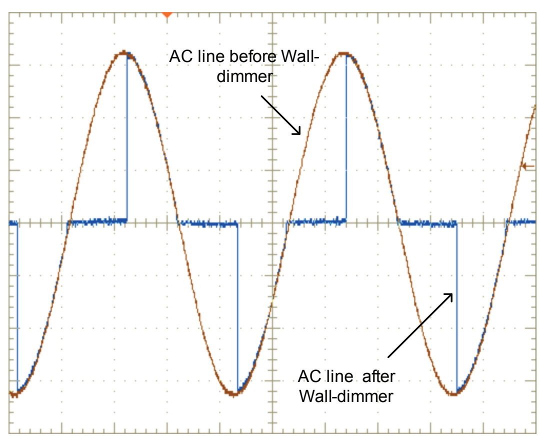


Figure 9.1 : Leading-Edge Wall Dimmer Waveforms

V_{CROSS} is internally generated by comparing the digitized V_{IN} signal to the threshold of 0.14V. The V_{IN} period (t_{PERIOD}) is measured between two consecutive rising edge zero-crossings. t_{CROSS} is generated by the internal digital block (refer to Figure 9.2); when V_{IN_A} is higher than 0.14V t_{CROSS} is set to high and when V_{IN_A} falls below 0.14V t_{CROSS} is reset to zero. If t_{CROSS} is much shorter than the V_{IN} period then a dimmer is detected. Using filtered derivatives the controller decides which type of dimmer is present. A large positive derivative value indicates a leading-edge dimmer, then the controller enters the leading-edge dimmer mode; otherwise it enters no dimmer mode.

During the dimmer detection stage, the OUTPUT(TR) is kept high to turn on the switching FET in the bleeding circuit, creating a resistive load for the wall dimmer.

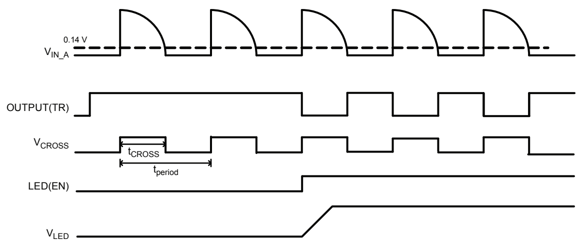


Figure 9.2 : Dimmer Detection

9.3 Dimmer Tracking and Phase Measurements

The dimmer detection algorithm and the dimmer tracking algorithm both depend on an accurate input voltage period measurement. The V_{IN} period is measured during the second cycle of the dimmer detection process and is latched for use thereafter. Using the measured V_{IN} period in subsequent calculations rather than a constant allows for automatic 50/60Hz operation and allows for a 10% frequency variation.

The phase measurement starts when V_{IN} exceeds the rising threshold until V_{IN} falls below the falling threshold.

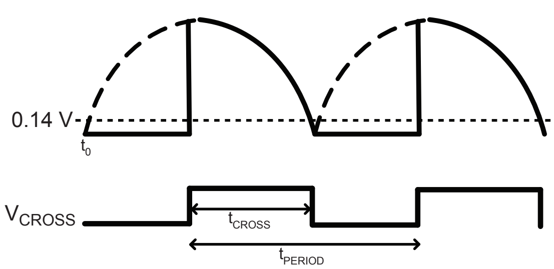


Figure 9.3 : Dimmer Phase Measurement

The dimmer phase is calculated as:

$$\text{Dimmer Phase} = \frac{t_{CROSS}}{t_{PERIOD}} \tag{9.1}$$

The calculated dimmer phase is used to generate the signal D_{RATIO}, which determines LED current. If the dimmer phase is less than 0.14 then the D_{RATIO} is clamped at 0.14; if the dimmer phase is greater than 0.7 then D_{RATIO} is clamped at 1.0; otherwise D_{RATIO} is calculated by equation 9.2.

$$D_{RATIO} = \text{Dimmer Phase} \times K_1 - K_2 \tag{9.2}$$

where, K_1 is set to 1.768 and K_2 is set to 0.238.

Using $V_{Isense(NOM)}$ to represent the nominal 100% LED current, the V_{Isense}, which modulates the output LED current, is controlled by:

$$V_{Isense} = V_{Isense(NOM)} \times D_{RATIO} \tag{9.3}$$

When D_{RATIO} is 1, the converter outputs 100% of nominal power to the LED. If D_{RATIO} is 0.01, the converter outputs 1% of nominal power to the LED.

9.4 Bleeding Operation

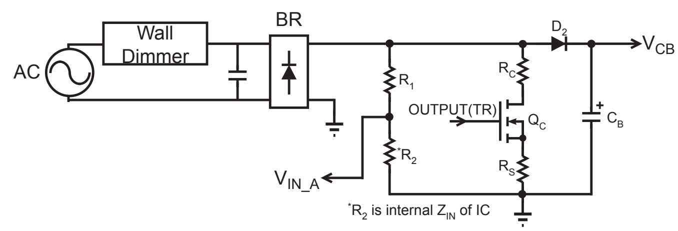


Figure 9.4 : Bleeding Schematic

A bleeding circuit provides the dynamic impedance for the dimmer and builds the energy to the LED power converter. It consists of Q_C, R_C, R_S, and D_2.

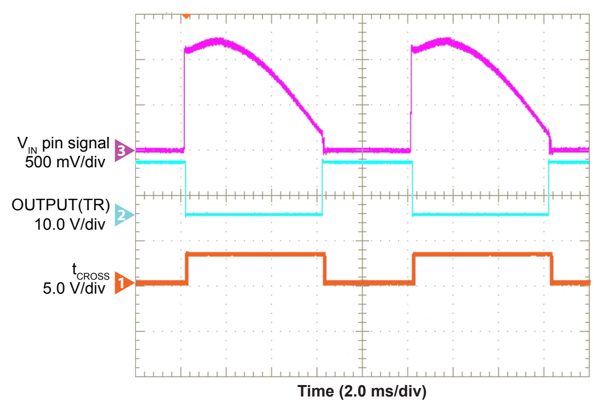


Figure 9.5 : Signals of Bleeding Circuit

Q_C is always on when t_{CROSS} is low and Q_C is always off when t_{CROSS} is high.

9.5 Start-up

Prior to start-up the V_{IN} pin charges up the V_{CC} capacitor through a diode between V_{IN} and V_{CC}. When V_{CC} is fully charged to a voltage higher than the start-up threshold $V_{CC(ST)}$, the ENABLE signal becomes active and enables the control logic, shown by Figure 9.6. When the control logic is enabled, the controller enters the configuration mode, where dimmer type and AC line period are measured. During the configuration mode, which is implemented during the first 3 half AC cycles, OUTPUT(TR) is kept high to determine the dimmer type and measure the AC line period. After the configuration mode the constant current stage is enabled and the output voltage starts to ramp up. When the output voltage is above the forward voltage of the LED, the controller begins to operate in constant output current mode.

An adaptive soft-start control algorithm is applied during start-up state, where the initial output pulses are short and gradually get wider until the full pulse width is achieved. The peak current is limited cycle by cycle by the I_{PEAK} comparator.

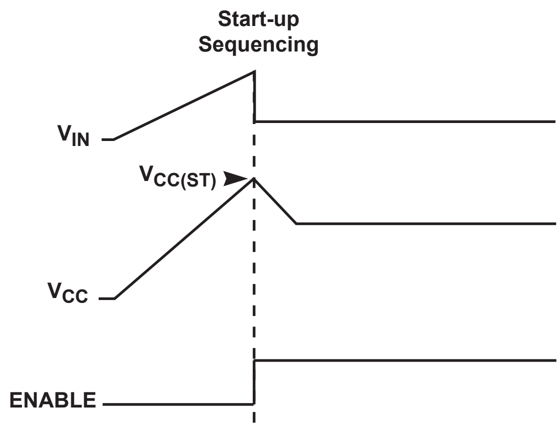


Figure 9.6 : Start-up Sequencing Diagram

9.6 Understanding Primary Feedback

Figure 9.8 illustrates a simplified flyback converter. When the switch Q_1 conducts during $t_{ON}(t)$, the current $i_g(t)$ is directly drawn from rectified $v_g(t)$. The energy $E_g(t)$ is stored in the magnetizing inductance L_M. The rectifying diode D_1 is reversely biased and the load current I_O is supplied by the secondary capacitor C_O. When Q_1 turns off, D_1 conducts and the stored energy $E_g(t)$ is delivered to the output.

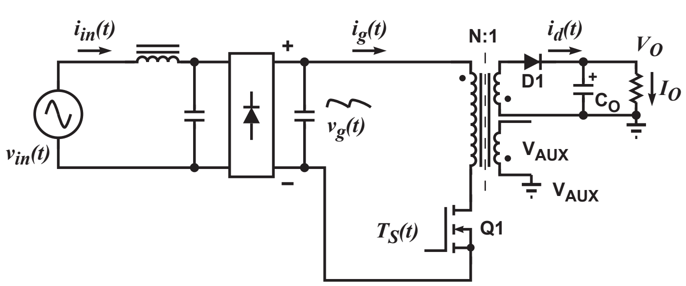


Figure 9.7 : Simplified Flyback Converter

In order to tightly regulate the output voltage, the information about the output voltage and load current must be accurately sensed. In the DCM flyback converter, this information can be read via the auxiliary winding or the primary magnetizing inductance (L_M). During the Q_1 on-time, the load current is supplied from the output filter capacitor C_O. The voltage across L_M is $v_g(t)$, assuming the voltage dropped across Q_1 is zero. The current in Q_1 ramps up linearly at a rate of:

$$\frac{di_g(t)}{dt} = \frac{v_g(t)}{L_M} \tag{9.6}$$

At the end of on-time, the current ramps up to:

$$i_{g\_peak}(t) = \frac{v_g(t) \times t_{ON}}{L_M} \tag{9.7}$$

This current represents a stored energy of:

$$E_g = \frac{L_M}{2} \times i_{g\_peak}(t)^2 \tag{9.8}$$

When Q_1 turns off, $i_g(t)$ in L_M forces a reversal of polarities on all windings. Ignoring the communication-time caused by the leakage inductance L_K at the instant of turn-off, the primary current transfers to the secondary at a peak amplitude of:

$$i_d(t) = \frac{N_P}{N_S} \times i_{g\_peak}(t) \tag{9.9}$$

Assuming the secondary winding is master and the auxiliary winding is slave.

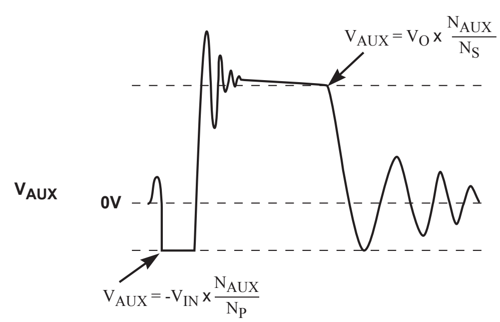


Figure 9.8 : Auxiliary Voltage Waveforms

The auxiliary voltage is given by:

$$V_{AUX} = \frac{N_{AUX}}{N_S}(V_O + \Delta V) \tag{9.10}$$

and reflects the output voltage as shown in Figure 9.9.

The voltage at the load differs from the secondary voltage by a diode drop and IR losses. The diode drop is a function of current, as are IR losses. Thus, if the secondary voltage is always read at a constant secondary current, the difference between the output voltage and the secondary voltage is a fixed ΔV. If the voltage can be read when the secondary current is small, for example, at the knee of the auxiliary waveform (see Figure 9.9), then ΔV is also small. With the iW3602-30C, ΔV can be ignored.

The real-time waveform analyzer in the iW3602-30C reads the auxiliary waveform information cycle by cycle. The part then generates a feedback voltage V_{FB}. The V_{FB} signal precisely represents the output voltage and is used to regulate the output voltage.

9.7 Valley Mode Switching

In order to reduce switching losses in the MOSFET and EMI, the iW3602-30C employs valley mode switching during constant output current operation. In valley mode switching, the MOSFET switch is turned on at the point where the resonant voltage across the drain and source of the MOSFET is at its lowest point (see Figure 9.9). By switching at the lowest V_{DS}, the switching loss is minimized.

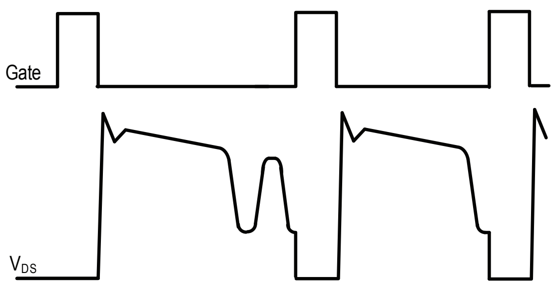


Figure 9.9 : Valley Mode Switching

Turning on at the lowest V_{DS} generates lowest dV/dt, thus valley mode switching can also reduce EMI. To limit the switching frequency range, the iW3602-30C can skip valleys (seen in the first cycle in Figure 9.9) when the switching frequency becomes greater than $f_{SW(MAX)}$.

At each of the switching cycles, the falling edge of V_{SENSE} is checked. If the falling edge of V_{SENSE} is not detected, the off-time is extended until the falling edge of V_{SENSE} is detected.

9.8 LED Current Regulation

The iW3602-30C incorporates a patented primary-side only constant current regulation technology. The iW3602-30C regulates the output current at a constant level regardless of the output voltage, while avoiding a continuous conduction mode. To achieve this regulation the iW3602-30C senses the load current indirectly through the primary current. The primary current is detected by the I_{SENSE} pin through a resistor from the MOSFET source to ground.

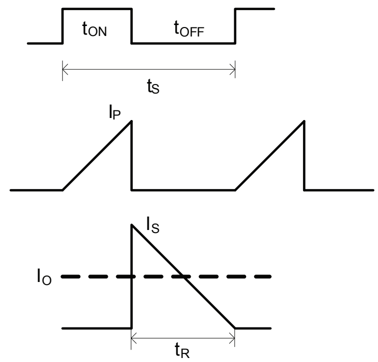


Figure 9.10 : Constant LED Current Regulation

The I_{SENSE} resistor determines the maximum current output of the power supply. The output current of the power supply is determined by:

$$I_{OUT} = \frac{1}{2} \times N_{PS} \times \frac{V_{REG-TH}}{R_{SENSE}} \times \frac{t_R}{t_S} \tag{9.11}$$

where N_{PS} is the turns ratio of the primary and secondary windings and R_{SENSE} is the I_{SENSE} resistor.

9.9 V_{IN} Resistors

V_{IN} resistors are chosen primarily to scale down the input voltage for the IC. The scale factor for the input voltage in the IC is 0.0086. Since the internal impedance of this pin is 2.5 kΩ, then, the V_{IN} resistors should equate to:

$$R_{Vin} = \frac{2.5k\Omega}{0.0086} - 2.5k\Omega = 288k\Omega \tag{9.12}$$

9.10 Voltage Protection Functions

The iW3602-30C includes a function that protects against an input over-voltage (V_{IN} OVP) and output over-voltage (OVP).

The input voltage is monitored by V_{IN_A}, as shown in Figure 8.1. If this voltage exceeds 1.73V for 15 continuous half AC cycles, the iW3602-30C considers V_{IN} to be over-voltage. Output voltage is monitored by the V_{SENSE} pin. If the voltage at this pin exceeds $V_{SENSE(MAX)}$ for 2 continuous switching cycles the iW3602-30C considers the output voltage to be over-voltage.

In both input over-voltage and output over-voltage cases, the IC remains biased, which discharges the V_{CC} supply. In order to prevent overcharging the output voltage or overcharging the bulk voltage, the iW3602-30C employs an extended discharge time before restart. Initially if V_{CC} drops below the UVLO threshold, the controller resets itself and then initiates a new soft-start cycle.

Under the fault condition, the controller tries to start up for three consecutive times. If all three start-up attempts fail, the controller enters the inactive mode, during which the controller does not respond to V_{CC} power-on requests. The controller is activated again after it sees 29 start-up attempts. The controller can also be reset to the initial condition if V_{CC} is discharged. Typically, this extended discharge time is around 3 to 5 seconds.

This extended discharge time allows the iW3602-30C to support hot-plug LED modules without causing dangerously high output voltages while maintaining a quick recovery.

9.11 PCL, OC and SRS Protection

Peak-current limit (PCL), over-current protection (OCP) and sense-resistor short protection (SRSP) are features built into the iW3602-30C. The I_{SENSE} pin enables the iW3602-30C to monitor the primary peak current; this allows for cycle by cycle peak current control and limit. When the primary peak current multiplied by the I_{SENSE} sense resistor is greater than V_{OCP}, OCP engages and the IC immediately turns off the gate drive until the next switching cycle. The output driver continues to send out switching pulses; the IC immediately turns off the gate drive if the OCP threshold is reached again.

To ensure that a shorted I_{SENSE} sense resistor does not cause any unsafe conditions to occur, the SRSP feature is enabled after start-up and shuts down the IC within one power supply cycle of the fault occurrence. The V_{CC} is discharged since the IC remains biased. In order to prevent overcharging the output voltage, the iW3602-30C employs an extended discharge time before restart, similar to the discharge time described in section 9.10.

9.12 Over-Temperature Protection

If an NTC thermistor is connected from the V_T pin to GND then, the iW3602-30C is able to detect and protect against an over--temperature event (OTP).

The iW3602-30C provides a current (I_{VT}) to the V_T pin and detects the voltage on the pin. Based on this voltage the iW3602-30C can monitor the temperature of the NTC thermistor. As the V_T pin voltage reduces, the iW3602-30C reduces the output current according to Figure 9.11 and Figure 9.12. There is a hysteresis of 84mV on V_T pin voltage for each power limiting step.

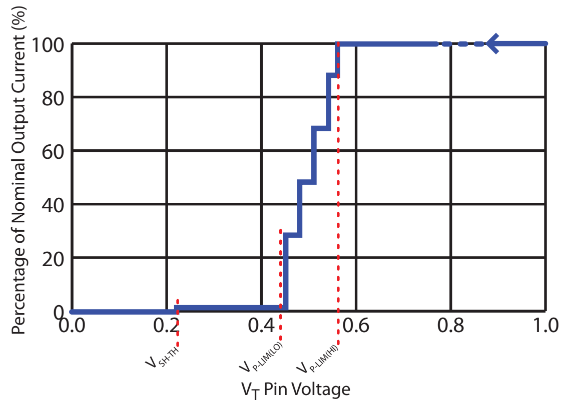


Figure 9.11 : V_T Pin Voltage vs. % of Nominal Output Current V_T from 1.0 V to 0.0 V

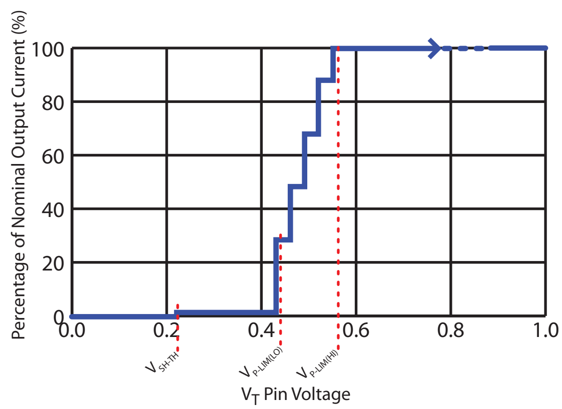


Figure 9.12 : V_T Pin Voltage vs. % of Nominal Output Current V_T from 0.0 V to 1.0 V

When the V_T pin voltage reaches $V_{P\text{-}LIM(HI)}$ the output current begins to reduce as shown in Figure 9.11. At $V_{P\text{-}LIM(LO)}$ the output current reduces to 1%. The device can be placed in shutdown mode by pulling the V_T pin to ground or under $V_{SH\text{-}TH}$.

10.0 Performance Characteristics

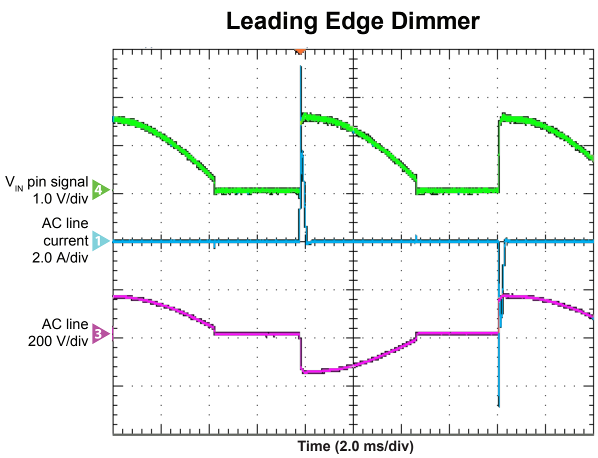


Figure 10.1 : Leading Edge Dimmer

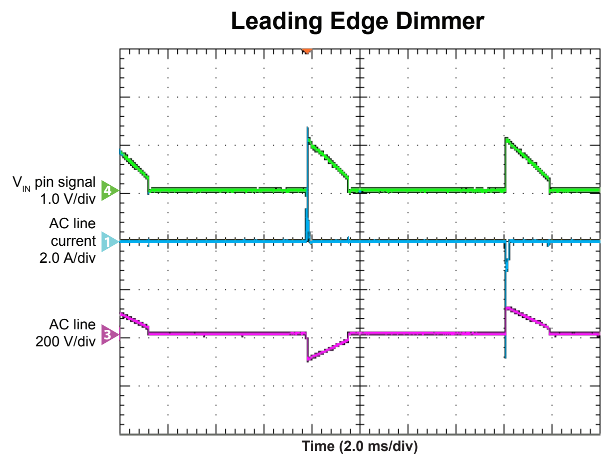


Figure 10.2 : Leading Edge Dimmer 2

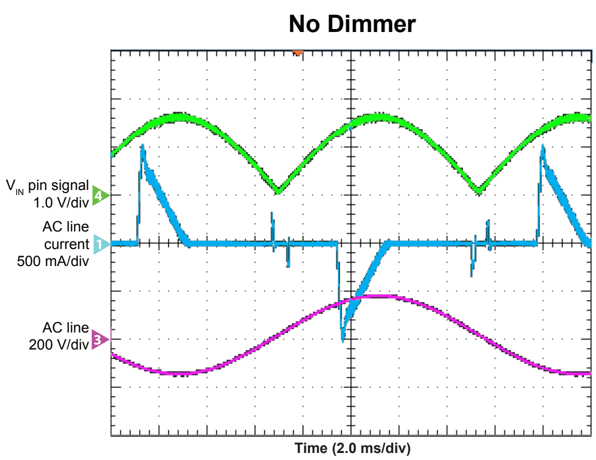


Figure 10.3 : No Dimmer

11.0 Typical Application Schematic

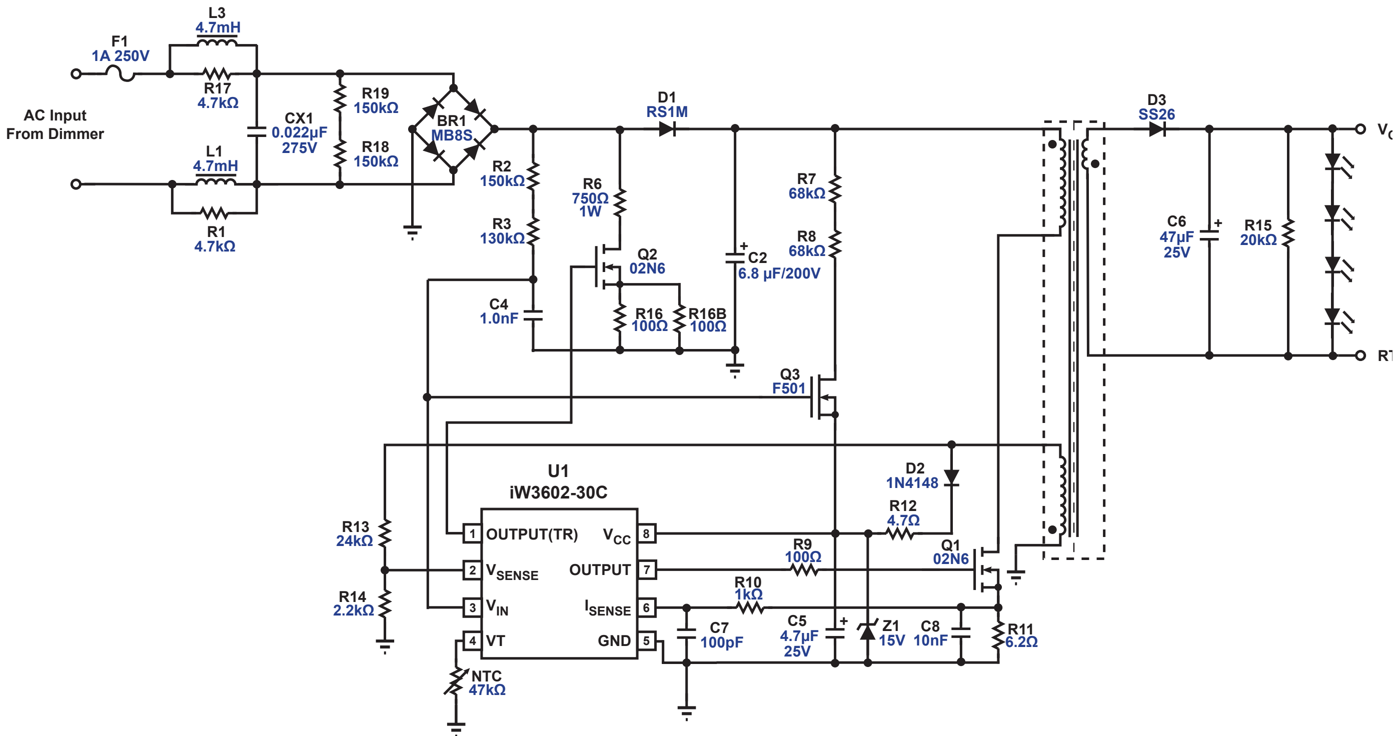
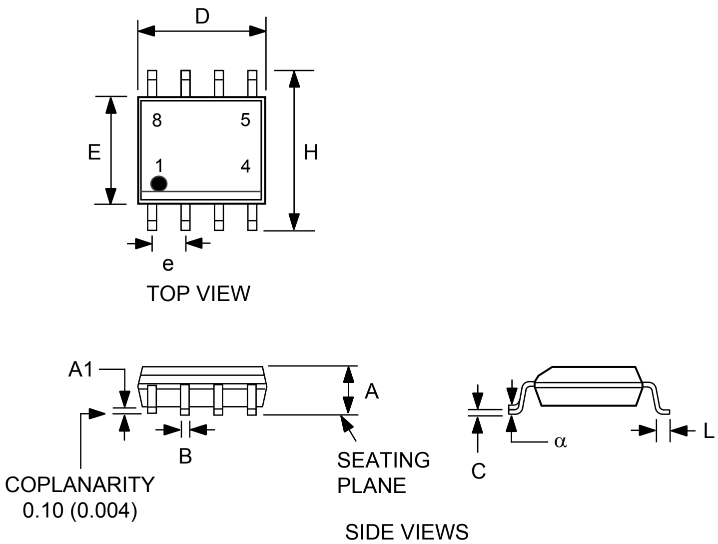


Figure 11.1 : iW3602-30C Typical Application Schematic

12.0 Physical Dimensions

8-Lead Small Outline (SOIC) Package



Symbol	Inches		Millimeters	
	MIN	MAX	MIN	MAX
A	0.051	0.067	1.30	1.70
A1	0.0020	0.0060	0.05	0.150
B	0.014	0.019	0.36	0.48
C	0.007	0.010	0.18	0.25
D	0.189	0.197	4.80	5.00
E	0.150	0.157	3.81	3.99
e	0.050 BSC		1.27 BSC	
H	0.228	0.244	5.79	6.20
N	0.086	0.094	2.18	2.39
M	0.118	0.126	3.00	3.20
L	0.016	0.050	0.41	1.27
α	0°	8°		

Compliant to JEDEC Standard MS12F

Controlling dimensions are in inches; millimeter dimensions are for reference only

This product is RoHS compliant and Halide free.

Soldering Temperature Resistance:
- [a] Package is IPC/JEDEC Std 020D Moisture Sensitivity Level 1
- [b] Package exceeds JEDEC Std No. 22-A111 for Solder Immersion Resistance; package can withstand 10 s immersion < 260˚C

Dimension D does not include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15 mm per end. Dimension E does not include interlead flash or protrusion. Interlead flash or protrusion shall not exceed 0.25 mm per side.

The package top may be smaller than the package bottom. Dimensions D and E are determined at the outermost extremes of the plastic body exclusive of mold flash, tie bar burrs, gate burrs and interlead flash, but including any mismatch between the top and bottom of the plastic body.

13.0 Ordering Information

Part Number	Options	Package	Description
iW3602-30C	PF < 0.7, Improved Bleeder	SOIC-8	Tape & Reel[1]

Note 1: Tape & Reel packing quantity is 2,500/reel. Minimum ordering quantity is 2,500.

AC/DC Digital Power Controllers for Dimmable LED Drivers

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RoHS Compliance

Dialog Semiconductor's suppliers certify that its products are in compliance with the requirements of Directive 2011/65/EU of the European Parliament on the restriction of the use of certain hazardous substances in electrical and electronic equipment. RoHS certificates from our suppliers are available on request.

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